

The systematic position of the Common Adder, *Vipera berus* (L.) (Reptilia, Viperidae), in North Korea and adjacent regions

Göran Nilson, Claes Andrén & Zbigniew Szyndlar

Abstract. The morphology of the population of *Vipera berus* occurring in North Korea is given, and the taxonomic position of this isolated southeastern population is discussed. By comparing it with material from all parts of the range for *Vipera berus* including all currently recognized subspecies (*berus*, *sachalinensis*, *bosniensis*) it is obvious that the North Korean population should be included in the easternmost subspecies *sachalinensis*.

Key words. *Vipera b. berus*, *V. b. sachalinensis*, *V. b. bosniensis*, North Korea.

The East Asian populations of *Vipera berus* were described as a separate subspecies by Carevskij (1917): *Vipera berus sachalinensis*. The type locality of this taxon is the island of Sakhalin. In 1926 Nikolski raised this taxon to species level and treated the East Asian mainland populations as a separate subspecies: *Coluber sachalinensis continentalis*. This new systematic division was never generally accepted by the taxonomists of the field, and all populations of *Vipera berus* of eastern Russia have currently been treated as one subspecies: *V. b. sachalinensis*.

The populations in North Korea and adjacent areas of China seem to have been overlooked in many papers dealing with the zoogeography of *Vipera berus* (e. g. Nikolsky 1964; Terentev & Chernov 1965; Mertens & Wermuth 1960; Saint Girons 1978, 1980; Schiemenz 1987), but discussed to some extent by others (e. g. Maki 1931; Shannon 1956; Won 1971; Kang & Yoon 1975; Paik 1982; Szyndlar & O 1987). Maki (1931) designated these Manchurian-Korean populations to the subspecies *sachalinensis*, and later students of Korean herpetofauna (Shannon 1956; Won 1971; Kang & Yoon 1975; Paik 1982) have followed this. To the contrary Zhao et al. (1981) and Szyndlar & O (1987) argued that these populations should be considered to belong to the nominate subspecies, *Vipera berus berus*, due to similarities in head scalation. The difference in dorsal scale ornamentation between *berus* and *sachalinensis* is weak (Groombridge, pers. inf.; Bea, pers. inf., and 1987), and the albumin immunological distance is small (Herrmann et al. 1987). The main purpose of this paper is to describe the isolated populations of *Vipera berus* in North Korea and adjacent Chinese territories, and to clarify its taxonomic status.

Material and Methods

Vipera berus has a large distribution, morphological variation, and degree of isolation (Nilson & Andrén, in press), and for an overall study of this species a large number of specimens, from a large number of localities throughout its entire range must be examined. However, as the work in this study is focused on the Korean populations, only specimens from restricted parts of the total range are examined for comparisons. The total material was divided into several

groups that reflected both traditionally subspecific division, and natural geographical subdivisions. The non-Korean material used for comparison was gathered from different parts of the Asian and European range of the species, and all three "old" subspecies, *berus*, *bosniensis*, and *sachalinensis* are represented. As the specific problem in this paper concerns the taxonomic status of the populations of *Vipera berus* in Korea, the East Asian and Korean material is divided into more subgroups than the remaining comparative material. The investigated material consists of specimens from:

1. North Korea (*Vipera berus*, 12 specimens) (NRM; ZIK).
2. Sakhalin, Russia, 10 specimens (*sachalinensis*) (ZIG).
3. Amur area, Russia, 2 specimens (*continentalis*).
4. East Europe (west Russia, Poland), 5 specimens (*berus*) (GNM).
5. Southwest Europe (Italy, Switzerland), 14 specimens (*berus*) (MZF; ZIG).
6. Northwest Europe (Sweden), 19 specimens (*berus*) (ZIG).
7. Balkan (former Yugoslavia, Bulgaria), 15 specimens (*bosniensis*) (NMW; ZIG).

In order to complete a total picture of the populations in Korea and adjacent Chinese territories available information from literature has been included as well, e. g.:

8. Korean specimens (20), from Won 1971.
9. Jilin (China) specimens (13), from Zhao et al. 1981.

Information from Saint Girons (1978) about all the subspecies of *Vipera berus* has been used when appropriate.

Museum Collections are cited as follows:

- NRM — Naturhistoriska Riksmuseet, Stockholm;
 ZIK — Zoological Institute, Korean Acad. Sci., North Korea;
 MZF — Museo Zoologico de "La Specola", Firenze;
 NMW — Naturhistorisches Museum Wien, Vienna;
 ZIG — Department of Zoology, University of Göteborg, Göteborg (authors collection, which later will be incorporated in GNM);
 GNM — Göteborg Natural History Museum, Göteborg.

Description of *Vipera berus* in Korea (figs 1—2)

The largest specimen in our material is a female with a total length of 690 mm and tail 62 mm; the latter is equal to 8.9 % of total length. The largest male has a total length of 590 mm and tail 70 mm; the latter is equal to 11.9 % of total length. The head is covered with rather large scales or plates. Two large supraoculars and 1 large frontal plate on top of head, parietals divided or fragmented, frontal separated from supraoculars by smaller scales on each side or in contact on one side or both, 1 canthal and 1 supranasal scale on each canthus rostralis, and one or two apicals in contact with rostral; 12 to 19 intercanthals and intersupraoculars. The rostral is bordered by 2 supralabials, 2 internasals and one or two apicals; eye surrounded by 9 to 12 circumoculars, a single subocular row on each side, 2 to 4 loreals on each side, upper preocular separated from nasal by a loreal in two thirds of the snakes, united with nasal in the rest, normally 9 supralabials (one snake has 8 on one side of head), and 11 to 12 sublabials on each side. Three to five preventrals and 141 to 159 ventrals, 28 to 33 subcaudals in females, 31 to 38 in males, all subcaudals in double rows, 21 dorsal scale rows at midbody and on neck one head-length behind the head, 16 to 19 dorsal scalerows one head-length anterior to anal. Dorsal pattern consisting of a zig-zag band or transverse bars containing 71 to 84 windings. Band normally continuous in females (up to 15 transverse bars in females); in males around 50 % of the zig-zag turns in the dorsal pattern separated into transverse bars, no melanistic specimens, lateral body blotches present, head pattern consists of 2 dark oblique

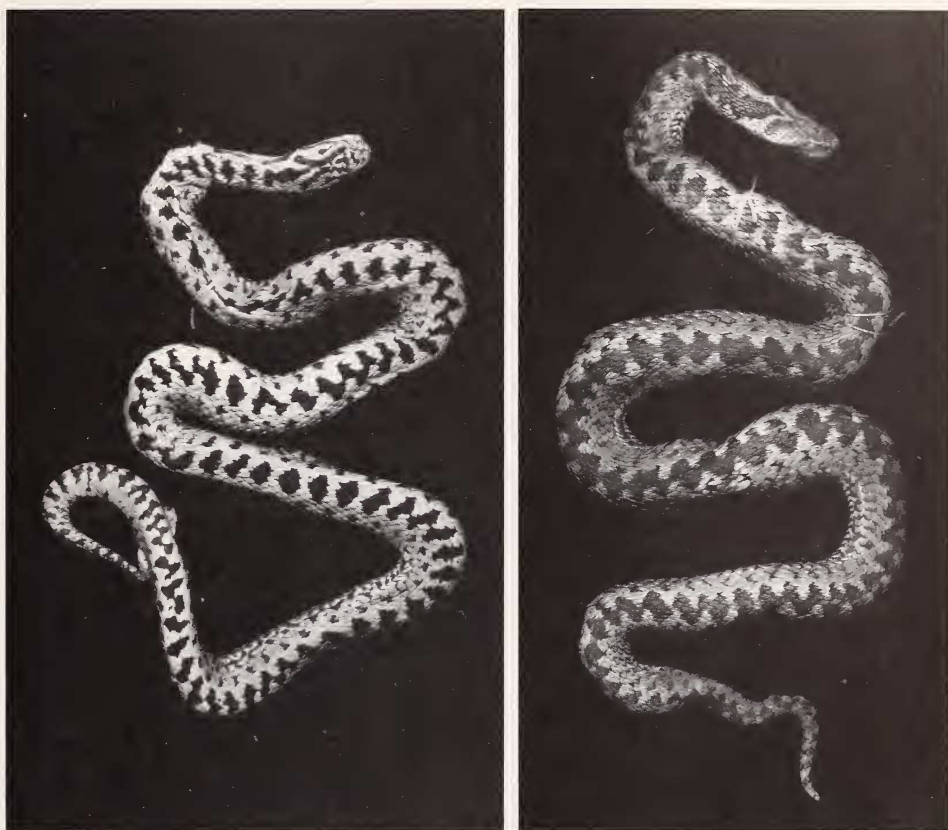


Fig. 1 (left): Male *Vipera berus* from North Korea (NRM SBM/1935.227.3019). — Fig. 2 (right): Female *Vipera berus* from North Korea (NRM SBM/1935.222.3020).

bands which do not unite, and a weak narrow posterior band from eye to corner of mouth, ground colour light brown with dorsal pattern dark brown, ventral side black.

Discussion

Geographically the *berus* range falls into a smaller eastern and a larger western part (fig. 4). This distributional pattern corresponds roughly to the division in subspecies with *sachalinensis* in the east and *berus* in central and western Russia and a major part of Europe (together with *bosniensis* in southern Europe). Some doubts have been expressed in literature about the systematic position of the eastern Russian mainland populations and of the Chinese and Korean ones. In external morphology as here examined (Tables 1 and 2) this east-west division agrees rather well with the traditional pattern of subspecies even though some minor differences can be seen. Data concerning the Korean specimens examined by us are in accordance with the

Table 1: Comparisons of *Vipera berus* from different parts of its range and of different subspecies. Based on own data and from Zhao et al. 1981 (= Zhao), and Won 1971 (= Won). Values given as mean and S. E.

	zig-zag turns	bands free, % in males	apicals	locals	crowns	supra- labials	sub- labials	circum- oculars
Korea (Won)	76±4	53	1.4±0.2	6.4±0.6	14.9±0.8	17.9±0.8	22.9±0.3	20.1±0.7
Korea (Zhao)			1.6±0.5			18.0		
Sakhalin	81±4	58	1.9±0.1	5.6±0.4	13.1±0.9	17.9±0.7	22.1±1.6	22.7±1.5
Amur area	77±3	38	(1.)	6.0±2.0	19.0±8.0	18.2±0.3	20.8±0.4	20.4±0.3
East Europe	78±2	1	1.8±0.2	4.4±0.2	19.0±2.1	18.0±0.0	20.0±0.0	18.5±0.5
N. W. Europe	74±2	0	1.9±0.1	6.0±0.7	16.6±1.2	17.1±0.3	20.6±0.4	17.8±0.5
S. W. Europe	64±3	4	1.9±0.1	6.4±0.4	13.6±0.7	17.7±0.2	20.6±0.3	19.0±0.4
Balkan	55±3	60	2.0±0.0	8.0±0.6	15.0±0.6	17.7±0.2	20.8±0.3	18.4±0.6
						18.3±0.2	21.7±0.4	19.3±0.7

Table 2: Comparisons of ventrals and subcaudals of *Vipera berus* from different parts of its range and of different subspecies. Based on own data and from Zhao et al. 1981 (= Zhao), and Won 1971 (= Won). Values given as mean and S. E.

	Males		Females	
	N	ventrals	N	subcaudals
Korea (own)	4	144.7±1.3	6	151.8±0.9
Korea (Won)	10	148	10	31.2±0.9
Jilin (Zhao)	4	146.8±0.9	9	(28.7*)
Sakhalin	7	146.9±1.1	3	151.3±0.9
Amur area	1	146	1	154.7±0.9
East Europe	2	143.5±1.5	3	28.3±0.7
N. W. Europe	10	140.7±0.9	4	31
S. W. Europe	11	139.5±1.2	3	146.3±1.5
Balkan	9	142.1±0.9	6	145.5±3.2
				30.3±0.8
				141.3±1.5
				25.3±1.5
				143.7±1.9
				30.2±0.7

*) The subcaudal numbers given by Won (1971) create some confusion. Min. and max. values are given as 31 and 41, with a mean of 24.81 for what Won refers as females. Corresponding numbers for males according to Won are 25 to 32 (X = 28.7). It is obvious that Won has mixed the two sexes, and due to printing error got a mean value of 24.8 (for 34.87) which is below the total subcaudal range for *Vipera berus* within its entire geographical range.

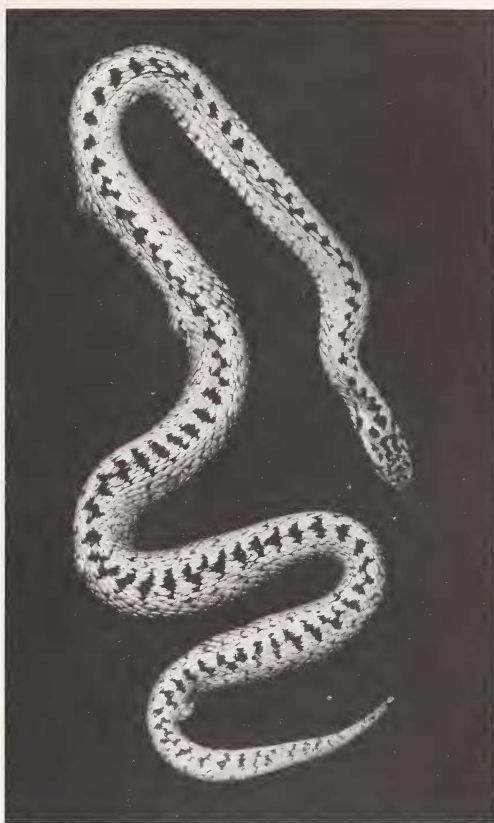


Fig. 3: Male specimen (ZIG 0108) of *Vipera berus sachalinensis* from the island of Sakhalin.

information given by Won (1971) for the same geographical range. It also agrees very well with the information published by Zhao et al. (1981) concerning the populations in the neighbouring Chinese province Jilin. It is obvious from a morphological point of view that these Chinese and North Korean populations belong to the same taxon. These populations are, however, geographically isolated and separated from the remaining east Asian populations in the Amur area ("*continentalis*") and on the island of Sakhalin (*sachalinensis*). The question is whether these Chinese and Korean populations belong either to any of these subspecies, or to the nominate form, or constitute a taxon of their own. Several characteristics unite all east Asian populations and separate them from west Russian and European ones. Such characters are a high degree of isolated transverse bars in the zig-zag dorsal band; a slightly higher number of supralabials; a higher number of ventrals in males; a tendency of having anterior corners of the frontal in contact with the supraoculars on one side or both; and in having the upper preocular reaching the nasal. Some of these characters, such as barred dorsal pattern and high number of supralabials can also be seen in the

populations occurring on the Balkan peninsula in Europe (*bosniensis*) and may be considered as cases of parallelism if apomorphic. But these characteristics seem rather symplesiomorphic and of comparatively low value for phylogenetic evaluations. However, the shape and size of the frontal and preocular must be considered as unique for these eastern populations and may express autapomorphic stages for *sachalinensis*.

There are also some differences within the east Asian group. The Amur populations are more similar to the western populations in several characters than the remaining east Asian populations (consisting of the Sakhalin and the isolated Chinese and north Korean populations). Characters such as number of circumoculars, and ventrals in females are higher in these latter populations while number of crownscales (intersupraoculars and intercanthals) are lower in the Amur and European populations.

Now, the Chinese-Korean populations (figs 1–2) and the Sakhalin population (fig. 3) seem rather similar, but still there is some morphological separation between these two groups. The Chinese-Korean group has a tendency towards a lower number of apicals in contact with rostral, and a higher number of sublabials (Table 1) as compared to the Sakhalin population as well as the remaining ones in Asia and Europe (with the exception of *bosniensis* in Europe which also has a high number of sublabials).

The Korean group is also similar to the Sakhalin and Amur populations in the characters that traditionally have been connected to the subspecies *sachalinensis*

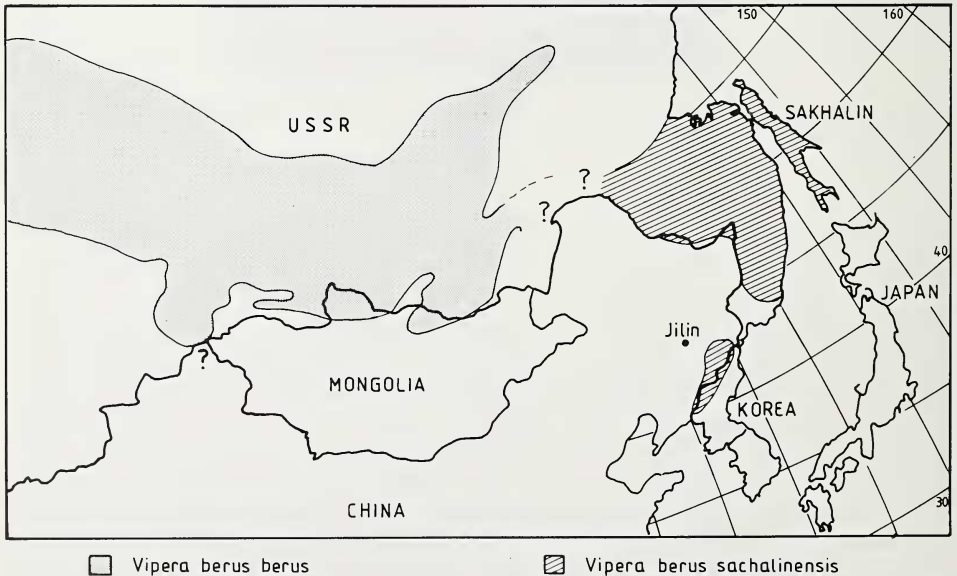


Fig. 4: Distribution of the different subspecies of *Vipera berus* in the Far East. Former USSR — after Bannikov et al. 1977; Mongolia — after Bannikov 1958; China — after Anonymus 1980.

(although in a lower frequency than in Amur and Sakhalin populations): frontal in contact with supraoculars and upper preocular in contact with nasal. In our material 63 % of the Sakhalin specimens had the frontal in contact with the supraoculars on one side or both. Corresponding figures in Amur and Korean specimens are 50 % and 33 %. Further 100 % of the Sakhalin specimens had the upper preocular in contact with the nasal. Corresponding figures in Amur and Korean specimens are 50 % and 29 %. We believe that these characters can be considered diagnostic for the subspecies *sachalinensis*, but should not be looked upon as crucial for the definition of this taxon. As has been shown above several characters can show up in different populations as in *sachalinensis* and in *bosniensis* and thus are parallel traits assumed that they are derived. The situation with the upper preocular in contact with the nasal that is frequent in *sachalinensis* can show up infrequently in *berus* as well. In a Swiss population of *berus* 86 % of the examined snakes (7) had one or both upper preoculars in contact with the nasals. One special feature that we found in *sachalinensis* is that some of the subcaudals in the double subcaudal rows were united into a single row. This feature was found in about 60 % of the specimens examined, and also in one of the two Amur specimens examined. It was not found in any of the Korean specimens. However, the conclusion is that all the eastern populations, including the Korean ones, are considered one subspecies: *sachalinensis*. The traditional subspecific pattern thus persists, but with the distributional change that also the Chinese and Korean populations should belong to this subspecies (fig. 4).

Acknowledgements

Korean specimens used in this study were collected by Sten Bergman 1935 and provided by Carl Edelstam and Sven Olander, Naturhistoriska Riksmuseet, Stockholm, as well as by O Hung Dam, Zoological Institute, Korean Acad. Sci., North Korea. Additional preserved material originates from Hans Neumeier, Zürich; Prof. Dr. Benedetto Lanza, Museo Zoologico de "La Specola", Firenze; Julian Dziubinski, Roumania; Franz Tiedemann, Naturhistorisches Museum Wien; and from Göteborg Natural History Museum. To all these persons and institutions we are indebted. This work has partly been supported by the Swedish Natural Sciences Research Council.

Zusammenfassung

Es wird über die Morphologie der Population von *Vipera berus* in Nordkorea berichtet und die taxonomische Position dieser isolierten südöstlichen Population diskutiert. Beim Vergleich mit Material aus allen Teilen des Gebietes für *Vipera berus*, einschließlich aller bis dato anerkannten Unterarten (*berus*, *sachalinensis*, *bosniensis*), ist es offensichtlich, daß die nordkoreanische Population in die östlichste Unterart *sachalinensis* eingeschlossen werden sollte.

Literature cited

- Anonymus (1980): "An Illustrated Monograph of the snakes of China". — Shanghai (Shanghai Kexuejishu Chubanshe), 166 pp. (in Chinese).
- Bannikov, A. G. (1958): Data on the fauna and biology of Amphibia and Reptilia in Mongolia. — Bull. Moskovs. Obsh. Ispyt. Prirody, Otd. Biol. 63 (2): 71–91 (in Russian with English Summary).
- Bea, A. (1987): Contribución al conocimiento des género *Vipera* (Reptilia, Viperidae): la micror ornamentación del Oberhäutchen. — Unpublished Ph. D Thesis; Barcelona, 554 pp.

- Carevskij, S. T. (1917): Formes nouvelles du genre *Vipera*, trouvées dans l'Empire Russe: *Vipera tigrina* sp. n. et *Vipera berus sachalinensis* var. nova. — Ann. Mus. zool. Acad. Imp. Sci., Petrograd, 21: 34–39.
- Herrmann, H. W., U. Joger, G. Nilson & C. G. Sibley (1987): First steps towards a biochemically based reconstruction of the phylogeny of the genus *Vipera*. In: Gelder, J. J. van, Strijbosch, H. & P. J. M. Bergers (eds): Proc. Fourth Ord. Gen. Meet. S. E. H.: 195–200. — Nijmegen (Faculty of Sciences).
- Kang Y. S. & Yoon I. B. (1975): Illustrated encyclopedia of fauna and flora of Korea, vol. 17: Amphibia-Reptilia. — Seoul (Ministry of Education), 191 pp. (in Korean).
- Maki, M. (1931): A monograph of the snakes of Japan. — Tokyo (Dai-Ichi Shobo Publ.), 240 pp.
- Mertens, R. & H. Wermuth (1960): Die Amphibien und Reptilien Europas (Dritte Liste nach dem Stand vom 1. Januar 1960). — Frankfurt am Main (Kramer), 264 pp.
- Nikolsky, A. M. (1926): *Coluber (Vipera) sachalinensis* (Car.) et son histoire. — Ann. Mus. Zool. Ac. Sci. Leningrad, 27: 247–260.
- Nikolsky, A. M. (1964): Fauna of Russia and adjacent countries, Reptiles, vol. 2. — Jerusalem (Israel Program for Scientific Translations), vi+247 pp. (Translation of work of 1916).
- Nilson, G. & C. Andrén (in press): Kreuzotter — *Vipera berus* (Linnaeus, 1758). In: Böhme, W. (ed.): Handbuch der Reptilien und Amphibien Europas. — Wiesbaden (Aula Verlag).
- Paik, N. K. (1982): Systematic studies on the suborder Serpentes (Reptilia) in Korea. — Kangreung (Kangreung Natl. Univ.), 86 pp. (in Korean with English summary).
- Saint Girons, H. (1978): Morphologie externe comparée et systématique des Vipères d'Europe (Reptilia, Viperidae). — Revue suisse Zool. 85: 565–595.
- Saint Girons, H. (1980): Biogéographie et évolution des vipères européennes. — C. R. Soc. Biogéogr. 496: 146–172.
- Schiemenz, H. (1987): Die Kreuzotter. — Wittenberg-Lutherstadt (A. Ziemsen Verlag; Die Neue Brehm-Bücherei), 108 pp.
- Shannon, F. A. (1956): The reptiles and amphibians of Korea. — Herpetologica 12 (1): 22–49.
- Szyndlar, Z. & O H. D. (1987): Reptiles of the Democratic People's Republic of Korea. Part I. Serpentes. — Chinese Herp. Res. 1987: 22–59.
- Terentev, P. V. & S. A. Chernov (1965): Key to amphibians and reptiles. 3rd ed. — Jerusalem (Israel Program for Scientific Translations), 315 pp. (Translation of work of 1949).
- Won H. K. (1971): amphibian and Reptilian fauna of Korea. — Pyongyang (Kwahagwon Chulpansa), 170 pp. (in Korean).
- Zhao E., Yan Z. & Song Y. (1981): Notes on common adder from north-eastern China. — Acta Herp. Sinica 5 (1): 1–4.

Göran Nilson and Claes Andrén, Department of Zoology, University of Göteborg, Medicinargatan 18, S-413 90 Göteborg, Sweden. — Zbigniew Szyndlar, Polish Academy of Sciences, Institute of Systematics and Evolution of Animals, Slawkowska 17, PL-31-016 Kraków, Poland.